EXHIBIT A

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re United States Patent Application of:		**Docket No.:** 4241-198-CON
Applicants:	**BARETZ, Bruce**	**Conf. No.:** 2836
Application No.:	**10/623,198**	**Art Unit:** 2814
Date Filed:	**July 18, 2003**	**Examiner:** Thao X. Le
Title:	**SOLID STATE WHITE LIGHT EMITTER AND DISPLAY USING SAME**	**Customer No.:** 23448

DISCUSSION DOCUMENT
USPTO INTERVIEW WITH EXAMINER THAO LE ON AUGUST 20, 2007
U.S. PATENT APPLICATION NO. 10/623,198

This addresses the Final Rejection in the Office Action dated June 26, 2007, of claims 31-38 and 43-52 of U.S. Patent Application No.10/623,198.

It is noted that **claims 43-52 were not previously considered on the merits**, and therefore a final rejection is not appropriate. Such claims appear to have been overlooked in the prior action on this application. It therefore is requested that the Office Action be reissued with the finality of the rejection withdrawn.

The claims under consideration are set out below.

31. A **display** including at least one light emission device, wherein **each light emission device** comprises an **LED energizable to emit radiation with an emission maximum in a spectral range of the blue to ultraviolet spectrum**, and a **luminophoric medium arranged to be impinged by radiation emitted from the LED and to responsively emit radiation in a range of wavelengths, so that radiation is emitted from the light emission device as a white light output.**

32. The display of claim 31, wherein the luminophoric medium of each light emission device comprises phosphor material.

33. The display of claim 31, wherein the luminophoric medium in each light emission device comprises a material responsively emitting radiation in at least the green spectrum.

34. The display of claim 31, wherein the LED in each light emission device comprises a blue light LED.

35. The display of claim 31, wherein the white light output of each light emission device comprises **primary radiation emission from the LED** and **secondary radiation emission from the luminophoric medium**.

36. The display of claim 31, wherein the LED in each light emission device comprises a material selected from the group consisting of: gallium nitride; indium gallium nitride; aluminum gallium indium nitride; aluminum gallium nitride; and indium nitride.

37. The display of claim 31, comprising a **liquid crystal display**.

38. The display of claim 31, comprising a backlight display.

43. The display of claim 31, wherein the **luminophoric medium in each light emission device comprises a material responsively emitting radiation in at least the yellow spectrum.**

44. An apparatus comprising a display, electrical circuitry operatively coupled with the display, and at least one light emitter including an LED operatively coupled with the electrical circuitry and energizable to emit radiation with an emission maximum in a spectral range of the blue to ultraviolet spectrum, and a luminophoric phosphor medium arranged to be impinged by radiation emitted from the LED and to responsively emit radiation in a range of wavelengths, so that radiation is emitted from the light emitter as a white light output.

45. The apparatus according to claim 44, wherein the display comprises a liquid crystal display.

46. The apparatus according to claim 45, wherein the light emitter provides illumination for the liquid crystal display..

47. The apparatus of claim 44, wherein the luminophoric phosphor medium comprises a phosphor material responsively emitting radiation in at least the green spectrum.

48. The apparatus of claim 44, wherein the luminophoric phosphor medium comprises a phosphor material responsively emitting radiation in at least the yellow spectrum.

49. The apparatus of claim 44, wherein the LED comprises a blue light LED.

50. The apparatus of claim 44, wherein the white light output of the light emitter comprises primary radiation emission from the LED and secondary radiation emission from the luminophoric phosphor medium.

51. The apparatus of claim 44, comprising a multiplicity of light emitters.

52. The apparatus of claim 44, comprising a power supply operatively coupled with said electrical circuitry.

REMARKS

Stevenson discloses a LED and a phosphor, in which the LED produces violet light (column 1, lines 10-12 of Stevenson - "[T]his invention relates generally to light emitting diodes and more particularly a violet light emitting diode"). See also column 1, lines 26-27 of Stevenson ("[I]t is a general object of the present invention to provide a violet light emitting diode.")

To achieve such light emitting diode emission, Stevenson teaches a structure including a sapphire substrate having deposited thereon a layer of n-type gallium nitride, on which has been deposited a magnesium-doped gallium nitride layer to compensate the n-type material and form a substantially intrinsic GaN:Mg layer forming an i-n junction with the n-type gallium nitride

layer. Leads are connected to the magnesium-doped gallium nitride layer and to the n-type gallium nitride layer, to constitute the structure as shown in FIG. 3 of the Stevenson reference.

The Stevenson reference discloses that this structure when powered in a forward bias mode will produce violet light, and that under reverse bias conditions, greenish light can be produced (see column 2, lines 55-64 of Stevenson).

In the paragraph bridging columns 3 and 4 of Stevenson, it is disclosed that:

> "... there has been provided an improved light emitting diode capable of emitting light in the violet region of the spectrum. This device may be used as a source of violet light for applications where this spectral range is appropriate. This light maybe converted to lower frequencies (lower energy) with good conversion efficiency using organic and inorganic phosphors. Such a conversion is appropriate to develop different colors for aesthetic purposes, but also to produce light in a spectral range of greater sensitivity for the human eye. By use of different **phosphors, all the primary colors may be developed** from this same basic device. An **array of such devices may be used for color display systems**: for example, a solid state TV screen."

This discussion of developing "different colors" or "light in a spectral range of greater sensitivity for the human eye" or "primary colors" is not a disclosure of "a white light output" as required by all of applicants' claims.

The examiner concedes this – he acknowledges that "the prior art does not specially disclose the 'white light' limitation" (page 4 of the June 26, 2007 Office Action), but then contends that "this feature is either inherent or obvious because the phosphor disclosed by Stevenson and in combination with Kitagawa and/or Tadamoto is substantially identical to that of the claims, claimed properties or functions are presumed to be inherent."

There is no basis for the "substantially identical" contention, since **Stevenson does not anywhere identify the phosphor**. Further, **the phosphor of Stevenson cannot be identical, since it does not produce a "white light output."** This is apparent from the disclosure in Stevenson that

> "[B]y use of different phosphors, all the primary colors may be developed from this same basic device. An array of such devices may be used for color display systems: for example, a solid state TV screen."

Stevenson therefore contemplates an array of devices, each of which produces a primary color (red, green and blue are the primary colors), to constitute an RGB array. There is no white light output. The disclosure of "different colors" and "primary colors" is a disclosure of single colors, not a white light output.

Accordingly, even if one were to replace the violet LED of Stevenson with a blue/UV LED of Kitagawa or Tadamoto, **one still would not alter the fact that the resulting output would be a single color output**, since Stevenson uses a phosphor that produces a single color, such as red, or green, or blue, as expressly taught ("primary colors") by Stevenson.

Since all of applicants' claims require a "white light output" and (Stevenson + Kitagawa + Tadamoto) ≠ "white light output," there is no basis for obviousness of applicants' claimed invention, and the rejection of the claims should be withdrawn on such grounds.

Rejection Based on References Including Ditzik

Ditzik at column 2, line 66 to column 3, line 13 discloses

> "Certain flat panel display devices, such as Liquid Crystal Displays (LCD), may require a backlight for better viewability. A number a [sic] backlight technologies are known to provide a relatively uniform light to the back of display panels. Prior art in backlights include electro luminescent, ***fluorescent, incandescent, and LED light sources. A number*** of light guide devices have been used to apply light to the rear of the display panel, using various fiber, glass, and plastic optical guides. However, several problems arise when the display must be viewed under sunlight, twilight, or night conditions. Each of these viewing conditions require different backlighting designs. The new multiple backlight invention described herein solves these problems by providing a simple way of using multiple light sources and integrating their light to the rear of an LCD panel."
>
> (Ditzik, column 2, line 66 – column 3, line 13; emphasis added)

This passage in its entirety simply mentions LED light sources as one of a variety of types of light sources (including electroluminescent, fluorescent, and incandescent) used in the prior art. There is no elaboration of the structure, composition, operating characteristics or any other information or detail relating to what "LED light sources" is or embodies. Further, this passage after mentioning each of these types notes their deficiency in not accommodating varied light

conditions ("several problems arise when the display must be viewed under sunlight, twilight, or night conditions").

The solution of Ditzik to this problem is a switchable system in which the user can select one or more of multiple light sources to adjust to a specific ambient lighting condition. Ditzik therefore requires provision of a multiplicity of types of light sources in order to provide the desired flexibility for viewing the LCD under varied ambient light conditions.

The question then becomes, given that Stevenson discloses "[A]n array" of single color light devices "for color display systems," as primary color (red, green, blue) devices, without any disclosure of the need for backlighting of such display, how and why would one, *a priori*, attempt any synthesis of Stevenson or Stevenson/Kitagawa with the LCD teachings of Ditzik?

The references themselves do not provide any clue as to how the single light color devices of Stevenson could be applied or implemented in a backlighting system of Ditzik. There is simply no specificity or guidance in any of the Stevenson, Kitagawa, Tadamoto or Ditzik references to provide any basis or logic for combination. There is no apparent way in which the Stevenson, Kitagawa, Tadamoto and Ditzik references can be combined to yield a display in which "radiation is emitted from the [LED/phosphor] light emission device as a white light output," as required by applicants' broad claim 31.

Rejection Based on References Including AAPA

The reference made in the Office Action to AAPA identifies specification pages 11-12 as describing a material responsively emitting at least in the green, yellow spectrum. The text of pages 11-12 is set out below.

> **"[0021] Japanese Patent Publication 04289691 of Mitsubishi Cable Industries, Ltd., published Oct. 14, 1992, discloses an electroluminescent device comprising a fluorescent dye-fixed silica layer coated with a transparent electrode layer, a luminescing (light-emitting) layer containing a phosphor, a backside electrode layer, a water-sorbing layer, an encapsulating film, and an insulating layer.**

[0022] In the Mitsubishi patent publication, the silica layer may be formed by a sol gel process using metal alkoxides in a solvent such as ethanol, isopropanol, or dimethyl ether. A Rhodamine 6G-doped silica layer is described to exhibit white luminescence. The luminescing layer may be for example on the order of 15 microns in thickness, and is formed by a sol gel technique yielding ZnS or ZnCdS doped with a dopant such as copper, aluminum, manganese, chlorine, boron, yttrium, or rare earth dopant. The luminescing layer may also contain scattered phosphor material. The average grain size of grains in the luminescing layer is generally greater than 10 microns, and preferably is in the range of from 15 to 40 microns. The luminescing layer may for example contain from 30 to 80% phosphor. A disclosed advantage of the foregoing structure is that one can change the phosphor in the luminescing layer, and thereby change the color of the whole material.

[0023] Japanese Patent Publication 60170194 of Sony Corporation, published Sep. 3, 1985, discloses a white light-emitting electroluminescent device with a luminescent layer containing a mixture of a blue-green-emitting phosphor and Rhodamine S. Since Rhodamine S strongly fluoresces orange by excitation with a bluish-green light, a white light of high luminosity may be obtained even at low voltage. This reference discloses a phosphor emitting blue-green light, in which ZnS is doped with Cu and Cl, as well as a phosphor emitting yellow light, in which ZnS is doped with Cu and Mn. ZnS may also be doped with Cu and Br to produce green light.

[0024] The Sony patent publication discloses a multilayer electroluminescent article, including sealing layers of protective film of a material such as Aclar polymer, a polyester layer, a transparent electrode formed of indium tin oxide (ITO), a light-emitting layer, and a backside electrode. The light-emitting layer may comprise 50-95% by weight of ZnS doped with the aforementioned dopant species (e.g., 0.045% wt. Cu, and 0.020% wt. Cl) and 5-50% wt. Rhodamine S.

[0025] Not withstanding the progress made in using organic fluorescers as luminescent sites within either electron-transport or hole-transport layers and affording thin-film interfacial hole-electron recombination, the current state of the art finds it difficult to generate organic based LED dies with reasonable operational lifetimes. By their very nature, these donor-acceptor complexes are prone to reaction with the surrounding medium. As a result, many of these organic molecules degrade under constant excitation to the excited state and consequently the organic-based LEDs fail. Those fluorescers with extremely high quantum yields of fluorescence, which by

> **definition necessitate short excited state lifetimes and are unlikely to be quenched or degraded by oxygen or other reactants, do not have sufficient electron or hole transport properties to allow for device-wide localized hole-electron recombination in the ground state. However, their proximity to the holes, as dopants in a hole transporting layer, as an example, may make the excited states of the luminophors more easily oxidized than would normally be the case. This would be especially true for excited state species, even if the ground state of the luminophors are stable to the holes in the hole-transporting layer. Similarly arguments regarding excited state reduction would be applicable for dopants sequestered within an electron-transport layer."**

The examiner is requested to clarify this basis of rejection, since no basis for extracting any of the foregoing into the Stevenson/Kitagawa/Tadamoto combination is present, and no basis for deriving the instant invention from Stevenson/Kitagawa/Tadamoto/pages 11-12 exists.

Secondary Evidence of Patentability

Significant secondary considerations provide compelling evidence of the nonobvious of the invention.

As stated in *Graham v. John Deere Co.*, 383 U.S. 1, 26 (1966):

> **Such secondary considerations as *commercial success, long felt but unsolved needs, failure of others*, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy. *Graham v. John Deere Co.*, 383 U.S. 1, 26 (1966) (emphasis added).**

As becomes clear from the following – all of the *Graham* secondary considerations (commercial success, long felt but unsolved needs, and failure of others) show the nonobviousness of the invention.

Inclusion of secondary considerations in the obviousness assessment is mandatory:

> **[E]vidence rising out of the so-called "secondary considerations" must *always* when present be considered en route to a determination of obviousness. . . . Indeed, evidence of secondary considerations *may often be***

> ***the most probative and cogent evidence in the record.*** **It may often establish that an invention appearing to have been obvious in light of the prior art was not. *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983) (emphasis added).**

<u>Long Felt But Unsolved Need</u>

The application describes generally the advantages of LEDs over other light sources such as incandescent bulbs. See Application, pg.1-4. In particular, LEDs are uniquely suited for many informational displays, e.g., commercial bank "time and temperature" message boards, stadium scoreboards, highway-mounted and portable vehicular control and information displays, "moving arrow" and other dynamically patterned lights on signs for hotels and casinos, etc.:

> **The practical advantages of LED displays over those using incandescent bulbs are many. The operational lifetime (in this case, defined as continual illumination) of a LED is on the order of 10 years or over 50,000 hours, whereas incandescent bulbs often burn out in the order of 2000 hours, thus leaving an empty pixel in the display message. Such recurrent failures make a display unreadable and, therefore, not useful. These conditions (i e, broken or missing pixels) require constant repair leading to a significant maintenance problem for providers of display signs based on incandescent illumination devices. With the long operational lifetime of a LED-based sign board, the pixels rarely burn out and the illuminated message remains legible over long operational periods.**
>
> **Similarly, LED lamps are considerably more robust. When exposed to stress, mechanical shocks, or temperature variations often encountered in an outdoor environment they are less likely to fail than incandescent lamps. . . . The solid state LED has no filaments to break and is housed within a durable plastic chamber, as the primary device envelope or package (typically being of considerable thickness), thereby exhibiting a high level of imperviousness to extreme outdoor environmental stresses.**
>
> Application, pg. 3-4.

Replacement of incandescent bulbs with LEDs in many of the aforementioned sign boards, however, is only practical if the LED emits **white light**. Conventional solid-state LEDs emit only single colors of light (e.g., red, amber, yellow-green, blue, etc).

As is demonstrated to every elementary school child in basic science by prismatically separating white light into its component spectral colors, white light is made up of a mixture of colors.

It is precisely this fact that was at the heart of the dilemma faced by the art, and unresolved until the applicants' inventive breakthrough – since white light is a mixture of colors, and LEDs only emit light of one color, how can white light, this mixture of many colors, be produced from a single LED?

The art had *no* answer to this question; its only solution for white light production from LEDs was to combine three different diodes. As a consequence, 3-element RGB (red, green, and blue) LED arrays – so-called "triplets" – came into the commercial arena, as products of companies such as Siemens Aktiengesellschaft in Germany and Ledtronics Inc. and Lumex Opto/Components in the United States. These products are still conventional and commercially available.

Failure of Others

Parallel to the development of "triplet" LEDs, another class of materials technology had been incubating in a half-dozen or more labs in the world – **organic light-emitting materials – that dated back to work in England in the early 1970s on conducting polymers and work at the University of Pennsylvania in 1977 on "synthetic metals."** Spurred by this work, many researchers joined the race to find new materials for use as conducting and semiconducting plastics.

Between 1987 and 1989 several researchers found that these materials could be made to emit light when doped properly and energized with a current. Lured by the vision of using cheaply manufacturable organic materials for light emission in the ultimate device – a light-emitting, low voltage, full color, monolithic electronic display – a number of major corporations and start-up companies mounted substantial R&D efforts.

Hundreds of millions of dollars were poured into the effort. The optimism that characterized the early efforts disappeared as the initial prototype organic light-emitting devices were tested, and researchers found that **device times to failure were measured in months and even shorter operating lives were achieved when the devices were integrated into multi-device displays.**

The initial dreams of early success were replaced by a more pragmatic focus on longer term development. Degradation of the organic material and short operating lifetimes continue to plague the efforts. **There are still to the present day no commercial long-life light-emitting organic devices of significance, despite the prior efforts and expended resources of companies such as**

Cambridge Display Technology (Cambridge, England), Eastman Kodak (Rochester, NY), Uniax Corporation (Santa Barbara, CA), and Pioneer, TDK and Idemitsu Kosan in Japan.

Commercial Success and Scientific Recognition

Against this background of failure of the art to achieve white light emission from a single LED, and failure of the art to achieve an organic light emitting material of any commercially viable character, **applicants in 1995 made a remarkable breakthrough - the invention of a single LED device for the production of white light. It was not until *two years later*, in 1997, that the *same* discovery was made by others – Nichia in Japan and Franhofer Institute in Germany – and hailed as a remarkable advance in the art.** Fraunhofer's publicity on the World Wide Web reported the news of the development (Fraunhofer-Gesellschaft: Research News Special 1997, at http://www.fhg.de/press/md-e/md1997/sondert2.htm; a copy of the text of this material is attached, and states:

> **"In contrast to the fragile and shortlived light bulb, lightemitting [sic] diodes, or for short [abbreviation] LEDs, are small, robust and highly efficient. LEDs are based on semiconductor chips which convert an electric current directly into light. A current of a few milliamps is sufficient to generate light resulting in a low power consumption. LEDs are cheap and have a lifetime of about 100,000 hours, or i.e. they emit light at a constant intensity for 11 years when operated 24 hours a day. Because of these advantages they have already found many applications in e.g., traffic lights, dashboards and as indicator lights in consumer electronics wherever replacement is cumbersome and expensive. Red, yellow, and yellowgreenish [sic] emitting LEDs have already been on the market for a long time, while blue and green emitting LEDs became commercially available only three years ago. By combining red, green, and blue emitting diodes, the generation of white light became possible. However, the emission of white light by a single chip LED was still impossible.**
>
> **This problem was solved by a research team at the Fraunhofer-Institut fur Angewandte Festkorperphysik IAF in Freiberg (Germany) and, at the same time, by their colleagues at Nichia Chemical Industries in Japan. Their innovative idea was to generate white light by luminescence conversion. They combined a blue emitting GaN LED with an organic dye or an inorganic phosphor, emitting at longer wavelengths, to synthesise white light by additive colour mixing. Peter Schlotter, a member of the IAF research team, points out a further advantage of the new luminescence conversion LEDs (LUCOLEDs): "LUCOLEDs allow to extend the range of colours emitted by LEDs to whatever colour is required, depneding on which conversion dyes or phosphors are used. Even purple light, which is impossible to be generated by conventional LEDs, can be emitted by**

LUCOLEDs." For the invention of the single chip white emitting LED the research team at the IAF was awarded the 1997 Franhofer Prize.

This simple but innovative and lowcost process, developed in close cooperation with Siemens AG, will enable mass production of white emitting LEDs. Siemens plans to start up production of white light single chip LEDs in 1998." (emphasis added)

The Franhofer/Nichia effort would have been a monumental success except for one fundamental fact.

At the time this breakthrough was announced, the applicants' parent application, U.S. Patent Application No. 08/621,937, was in its second year of PTO pendency.

The present inventors had won the race to solve the problem of getting white light from a single LED. Because of the secrecy in which U.S. patent applications are preserved, the world did not yet know this fact. The Fraunhofer publicity effort lauded the innovation and breakthrough achievement of the Fraunhofer scientists. The applicants however had been first to achieve white light output from a single LED, a genuine breakthrough that dramatically left behind "triplet" technology and the costs, fabrication issues and operational complexity of RGB arrays.

The race to produce a white light LED was waged in R&D labs throughout the world, by the brightest talent, and consumed millions of dollars. Its apparent winners were lauded in scientific and trade journals, and awarded prestigious prizes for their apparent victory. How, then, could applicants' *prior* conception and reduction to practice of their claimed invention be characterized as obvious to one of ordinary skill in the art?

The answer is that the applicants' claimed invention is not obvious. It represents a genuine innovation that merits allowance of the presently pending claims.

PAGE 15/15 * RCVD AT 9/20/2007 3:58:29 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-5/17 * DNIS:2738300 * CSID:9194199354 * DURATION (mm-ss):04-06